other values may also be employed in other embodiments and examples in accordance with the teachings of the present invention.

We claim:

1. A vertical power transistor device comprising:

a semiconductor layer of a first conductivity type;

a plurality of cylindrically-shaped dielectric regions disposed in the semiconductor layer, each cylindrically-shaped dielectric region having an outer side that extends in a vertical direction from a top surface of the semiconductor layer downward, each cylindrically-shaped dielectric region having a circular cross-section in a horizontal plane perpendicular to the vertical direction, adjacent ones of the cylindrically-shaped dielectric regions being laterally separated along a common diametrical axis by a narrow region of the semiconductor layer having a first width;

each cylindrically-shaped dielectric region having a cylindrical field plate member centrally disposed therein, the cylindrical field plate member having a circular cross-section in the horizontal plane and comprising a conductive material that fully extends laterally across a diameter of the circular cross-section of the cylindrical field plate member, the conductive material extending in the vertical direction from the top surface downward to near a bottom of the cylindrically-shaped dielectric region, the cylindrically-shaped dielectric region laterally separating the cylindrical field plate member from the narrow region;

a source region of the first conductivity type disposed at the top surface of the narrow region;

a body region of a second conductivity type, the body region separating the source from a lower portion of the narrow region, the lower portion comprising a drift region;

a drain region of the first conductivity type disposed beneath the semiconductor layer; and

a ring-shaped gate member disposed in each cylindrically-shaped dielectric region between the narrow region and the cylindrical field plate member.

2. The vertical power transistor device according to claim 1 wherein a lateral width of the cylindrically-shaped dielectric region separates the cylindrical field plate member from the narrow drift region, the lateral width being substantially the same at all points along a side surface of the cylindrical field plate member.

3. The vertical power transistor device according to claim 1 wherein the ring-shaped gate member is a planar gate member.

4. The vertical power transistor device according to claim 1 wherein the cylindrical field plate members each comprise polysilicon.

5. The vertical power transistor device according to claim 1 wherein a cell of the vertical power transistor device comprises a triad of the cylindrically-shaped dielectric regions in an equilateral triangular arrangement.

6. The vertical power transistor device according to claim 1 further comprising a substrate, the semiconductor layer comprising an epitaxial layer disposed on the substrate.

7. The vertical power transistor device according to claim 1 wherein the substrate is the first conductivity type.

8. The vertical power transistor device according to claim 1 wherein the substrate is a second conductivity type.

9. The vertical power transistor device according to claim 1 wherein the first conductivity type comprises n-type.

10. The vertical power transistor device according to claim 1 wherein each of the cylindrically-shaped dielectric regions extends downward into the drain region.

11. The vertical power transistor device according to claim 1 wherein the drift region has a doping concentration that varies from near the body region down to near the bottom of the drift region.

12. The vertical power transistor device according to claim 1 wherein the drift region comprises an epitaxial layer having a graded doping profile.

13. The vertical power transistor device according to claim 11 wherein the doping concentration is highest near the bottom of the drift region.

14. A high-voltage transistor comprising:

a substrate;

an array of cylindrically-shaped dielectric regions disposed in the substrate and arranged in an equilateral triangular layout, each of the cylindrically-shaped dielectric regions having an outer side that extends in a vertical direction from a top surface of the substrate downward, the cylindrically-shaped dielectric regions having a circular cross-section in a horizontal plane perpendicular to the vertical direction, adjacent ones of the cylindrically-shaped dielectric regions being laterally separated along a common diametrical axis by a narrow region of the substrate having a first width;

each cylindrically-shaped dielectric region having a cylindrical field plate member centrally disposed therein, the cylindrical field plate member having a circular cross-section in the horizontal plane and comprising a conductive material that fully extends laterally across a diameter of the circular cross-section of the cylindrical field plate member, the conductive material extending in the vertical direction from the top surface downward to near a bottom of the cylindrically-shaped dielectric region, the cylindrically-shaped dielectric region laterally separating the cylindrical field plate member from the narrow region;

a source disposed at the top surface of the narrow region;

a body region that separates the source from a lower portion of the narrow region, the lower portion comprising a drift region;

a drain disposed at the bottom of the substrate; and

a ring-shaped gate member disposed in each cylindrically-shaped dielectric region between the narrow region and the cylindrical field plate member.

15. The high-voltage transistor according to claim 14 wherein the gate member is a planar gate member.

16. The high-voltage transistor according to claim 14 wherein the cylindrically-shaped dielectric regions each comprises an oxide.

17. The high-voltage transistor according to claim 14 wherein the first width is in a range of approximately 1-2 microns wide.

18. The high-voltage transistor according to claim 14 wherein the narrow region has a doping concentration in a range of about $1\times10^{15}/cm^3$ to about $1\times10^{17}/cm^3$.

19. The high-voltage transistor according to claim 14 wherein each of the cylindrically-shaped dielectric regions extends downward into the drain.

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